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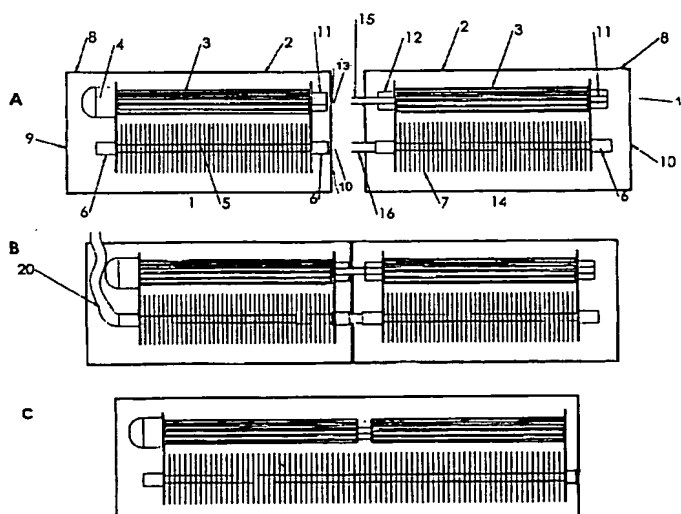
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(54) Title: VENTILATING AGGREGATE, UNITS, SYSTEM AND METHODE INCLUDING UNITS THAT ARE EASILY CONNECTABLE TO OTHER UNITS AND SAFETY SWITCH



(57) Abstract: A ventilating aggregate comprising one or more ventilating units is provided. The ventilating units are provided with means for connecting functionally to further ventilating units or external distribution systems. The ventilating aggregate is hence flexible with respect to i.a. length and heat transfer by varying the number and/or type of ventilating units. Furthermore, the ventilating aggregates are easy or fast to install and/or easy, cheap or fast to manufacture.

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**VENTILATING AGGREGATE, UNITS, SYSTEM AND METHODS  
INCLUDING UNITS THAT ARE EASILY CONNECTABLE TO  
OTHER UNITS AND SAFETY SWITCH**

**TECHNICAL FIELD OF THE INVENTION**

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The present invention relates to ventilating, particularly to a ventilating aggregate with at least one ventilating unit, said unit comprising a cross-flow blower and means for connecting said unit functionally to further ventilating units or an external distribution system. The invention also relates to methods of operation and to  
10 ventilating systems comprising a ventilating aggregate.

**BACKGROUND ART**

15 In the prior art, various ventilating devices having cross-flow blowers have been proposed.

WO 02/04871 discloses a ventilating device, which may circulate, heat or cool the air in a room or when ventilating devices are placed in adjacent rooms the same  
20 operation of either circulating, heating or cooling in all of these rooms. The ventilating device consists of one unit with a motor and at least two impellers. The unit is prepared for the specific application with regard to length.

US 4,733,542 discloses a ventilating system for heating and/or cooling with one  
25 cross-flow blower. The system is not intended for connection to other similar systems to form ventilating agglomerates.

**OBJECTS OF THE INVENTION**

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It is the object of the present invention to provide a ventilating aggregate that is flexible with respect to i.a. length and heat transfer by being built from one or more ventilating units.

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It is another object of the invention to provide ventilating units that are easily connectable to other ventilating units or to external distribution systems.

5 In another aspect of the invention, an object is to provide a ventilating aggregate, which is built from standardised units that may be built prior to transportation to the site of the installation.

A further object of the invention is to provide a ventilating aggregate, which is easy or fast to install and/or easy, cheap or fast to manufacture.

10

A further object is to provide ventilating units and ventilating aggregates that prevent accidental injury of the user.

15 DISCLOSURE OF THE INVENTION

The above and more objects are realised by the invention as described and explained in the figures, preferred embodiments and claims.

20 One aspect of the invention concerns a ventilating aggregate with at least one ventilating unit, said ventilating unit comprising a cross-flow blower with one or more impellers, means for driving said cross-flow blower and means for connecting a unit functionally to further ventilating units or an external distribution system.

25 The means for driving the cross-flow blower is typically a motor, preferably an electrical motor, or a connection transferring rotational force from another cross-flow blower. At least one of the units in any aggregate is equipped with a motor, whereas the other units may or may not be equipped with a motor. The rotational force may e.g. be connected by a frictional connection, an elastic connection, a gear or  
30 preferably by direct connection between the shafts of the cross-flow blowers.

The ventilation unit may or may not be equipped with a heat exchanger. If the ventilation unit is not equipped, then it is typically used for circulation of the air in a room, preferably filtering the air during the process of circulating the air. However,  
35 such a ventilation unit may also be connected to a fresh-air intake, where air from an

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other place, preferably outdoor, is moved into the ventilated room. If fresh air is used the ventilation is usually equipped with a filter. When using ventilation, 100% of the air may be fresh air, however, the fresh air may also be a fraction of the ventilated air, for example 10%, 25%, 50%, 75% or 90% fresh air. Use of a smaller fraction of  
5 fresh air than 100% may be energetically favourable, particularly when the temperature of the fresh air is much greater or smaller than the desired room temperature.

In a preferred embodiment, the ventilation unit is equipped with a heat exchanger.  
10 The heat exchanger may heat or cool the air interacting with the ventilation unit. Hence a ventilation unit with a heat exchanger may provide heating or cooling or ventilation or fresh air or any combination of two or more of these. The heat exchanger may be positioned before or after or both before and after the cross-flow blower in the direction of the dominant airflow. For example a heating unit may be  
15 provided before the cross-flow blower and a cooling unit may be provided after the cross-flow blower or vice versa. Another way of arranging the heat exchanger is to use a heat exchanger, which may provide heating or cooling dependent on the selected heat transfer medium. Preferably a heat exchange medium for cooling is used during summer and a medium for heating is used during winter.

20 Many types of heat exchangers may be utilised within the scope of the invention. Examples of usable heat exchangers are a pipe, a pipe with convector plates, a convector, a plate convector or a radiator. In case of a pipe heat exchanger, the pipe may have a circular cross section, which typically would be a cheap pipe, or it may  
25 have a different geometry like e.g. a more flat cross section like a rectangular shape, an elliptic shape or an oval shape. In case of a non-circular cross section, the pipe or pipes may be placed very close to the cross-flow blower yielding a very closely packed unit. The pipe is usually straight and substantially parallel to the axis or rotation of the cross-flow blower, but other geometries are possible like for example  
30 S-shaped pipes or pipes shaped as a spiral. In case of a pipe shaped as a spiral, the cross-flow blower is preferably encircled by the pipe or placed next to the pipe.

Convactor plates are typically placed substantially orthogonally to the rotational axis of the cross-flow blower to reduce the degree of turbulence. The spacing between  
35 and thickness of convactor plates depend strongly on the material of the plate, the

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desired rate of heat transfer and the desired flow pattern. The optimum configuration may be established empirically or by modelling.

5 In general, the geometrical shape and relative positioning of the elements within a unit may be optimised for yielding a desired flow pattern. Typically, a highly laminar pattern may reduce the noise emitted from the unit, whereas a highly turbulent pattern may increase the rate of heat transfer.

10 To realise a high rate of heat exchange, the heat exchanger should be positioned in the vicinity of the cross-flow blower and extend about the length of or longer than the impeller or impellers of the cross-flow blower.

15 The overall airflow to and from the ventilation unit is usually orthogonal to the rotational axis of the cross-flow blower and covers a substantial part of the length of the cross-flow blower, however, in some situations this is not the optimum configuration. For example when fresh air is used, the inlet may advantageously not extend at full length of the cross-flow blower. Furthermore, the direction of the outlet airflow may be guided off the orthogonal direction by the baffles or equivalent elements in the cover when this is desired. Such baffles may be stationary or  
20 movable. Movable baffles are especially advantageous when the ventilation unit may provide both heated and cooled or fresh air. The air may then be directed towards the floor when heating and towards the ceiling when cooling to obtain more comfortable air mixing or decrease draught. In case of movable baffles, the direction of the outlet airflow may be movable manually or automatically.

25 A ventilation unit according to the invention is prepared for connecting the unit functionally to further ventilation units and/or external distribution systems. The functional connection may provide distribution of fresh air and/or heat distribution medium and/or electrical power and/or rotational force between cross-flow blowers.

30 Fresh air and heat distribution medium may be distributed by piping systems. Such distribution systems may be prepared for connection by providing male/female type fittings in the ends in such a way that the male fitting of a first unit is connected to a female fitting of a second unit or vice versa. The types of fittings are preferably  
35 selected in a fashion to ensure that the pipes may only be connected in one single

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way to ensure that for example the pipes of the pipe for heating medium of a first unit are not connected to the cooling medium pipe of a second system.

5 The connections may be stiff, however, it is preferred that some flexibility with regard to distance and angle between units are available for the connection. As an example, this may be ensured for the heat distribution medium by use of flexible tubes securely fixed to a heat exchanger of a first unit in the first end and provided with a male/female type fitting in the second end for releasable connection to a heat exchanger of a second unit in the second end.

10

A connection for electrical power may be of a conventional male/female plug type. A connection for rotational force may be e.g. be of a frictional type connection, an elastic type connection, a gear type or preferably by direct connection between the shafts of the cross-flow blowers.

15

Means of connection is preferably of a snap type in the sense that the means may be secured in a fast and safe way.

20 The means of connection may be an individual means for each resource or type of resource. However, it will be appreciated that the means for connection may consist of a special plug connecting all the relevant resources from one ventilation unit to another by only one male/female connection.

25 A ventilating aggregate may have one, two or more ventilating units. If the ventilating aggregate have more than one unit, these units may be alike, optionally identical or at least two of the ventilating units may be different. If the units are alike, each unit must be equipped with a motor to drive the cross-flow blower. In this embodiment, the units will typically only vary slightly, e.g. in gearing of the cross-flow blower. Such difference in gearing may e.g. be incorporated in the process of transfer rotational force between adjacent units. Only one type of unit is used regardless of the length of the ventilating aggregate and hence, only one type of units should be stocked to be able to provide immediate delivery of any length of ventilating aggregates. However, if the units are different, one or more but not necessarily all of the units should be equipped with a motor. Often the end unit will be different from  
35 the other units, for example the end unit may be equipped with a motor, whereas the

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rotational force to drive the cross-flow blowers in other units may be transmitted between adjacent units. Furthermore, the end unit may in a preferred embodiment be equipped with a loop in the distribution system for the heat transfer medium. If the units are different, it is possible to make for example a very cheap non-end unit to combine with a more sophisticated end unit and hence keeping the overall price of the ventilating aggregate down.

A ventilating unit may be supported by a holding member that supports the individual elements of the unit in the desired relative position; however, in a preferred embodiment, the unit further comprises a frame for supporting the elements of the air conditioner, optionally by individual or combined holding members. Relevant elements to be supported by holding members may e.g. comprise a cross-flow blower and/or a distribution system for heat exchange medium.

Use of a frame to support the elements of the ventilation unit or holding members for these elements may be advantageous, since ventilation units with a frame are easier to handle and more mechanically stable during distribution and installation. Easy installation is further enhanced if the frame is equipped with a snap connection for securing the frame to the frame of adjacent ventilating units.

The ventilation unit may further comprise a cover. The cover serves a number of objects like for example:

- to prevent possible injury from contact to moving or hot/cold parts
- to protect the impeller and the rest of the ventilation unit from damaging foreign objects
- to control the direction of the outlet air and/or the inlet air
- to provide access to the ventilator for maintaining and cleaning purposes through the opening revealed when the cover is slid, pivoted or removed from the closed position
- to provide easy and fast means for changing of the appearance or external design of the ventilation aggregate by replacing the cover with a cover having another appearance.

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5 The cover is connected to the frame or to the holding members. The connection is preferably of a removable and/or semi-removable type. By removable type connection is meant that the cover may be completely removed from the ventilation unit. Such a connection may comprise screws, nails or equivalent or a point or line snap connection like a push stud or a hooks and loops connection. By semi-removable type connection is meant that the cover may be moved from a closed position to an open position, where the cover is still in contact with the frame or the holding members. Such a connection may for example be of a sliding or pivoting nature.

10

The cover is equipped with openings for passage of inlet and/or outlet air. These openings are preferably designed to reduce the feeling of draught. For example the openings may comprise elements that direct the outlet air along the length of the ventilation unit.

15

The flow of air that needs to interact with the ventilation aggregate depends on the demand for energy transfer under the consideration that the difference between room temperature and the outlet temperature of the ventilation aggregate should be limited. Preferably, the temperature difference should be less than about 15°C to prevent the user from experiencing the outlet air as uncomfortably hot or cold. Furthermore, the linear air velocity in the areas frequented by users of the room should be limited, preferably to less than about 2 m/s, to prevent the user from experiencing a draught near the ventilation aggregate. The allowable temperature difference is strongly correlated with the allowable linear air velocity, since a high temperature difference is more likely to be observed as a draught at a fixed linear air velocity than a low temperature difference. This is particularly the case during cooling, where the allowable temperature difference and linear air velocities usually are much lower.

30

These design restrictions (1. high flow of air to obtain high energy transfer, 2. low temperature difference and 3. low linear air velocity to prevent draught) may be realised simultaneously with a ventilation aggregate according to the invention. Practically speaking by having a relatively long ventilation aggregate and hence reducing the required energy transfer per meter ventilator aggregate and/or by utilising a cover with a relatively high area of openings.

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5 The cover and particularly the shape and extent of the openings influence the level of emitted noise from a ventilation unit. It is preferred that the cover is shaped to reduce the emitted noise for example by controlling the degree of turbulence in the airflow. The turbulence may for example be reduced by eliminating sharp corners in the airflow, whereas controlled increase in turbulence may be desired near the outlet to reduce draught.

10 In one preferred embodiment, members for supporting the cross-flow blower and/or the heat exchanger are integrated in or mounted to the cover. A ventilating unit with such a cover is easy to maintain and clean and if the demand for heating and/or cooling should change after installation of the unit, the elements connected to the cover may be changed by just changing the cover.

15 The level of emitted noise from a ventilation unit should preferably be reduced. Since a source of noise is turbulence in the airflow, the avoidance of shapes that introduce turbulence may reduce the noise level. In one preferred embodiment, this is realised by the use of one or more guide plates. The guide plates are placed between the air inlet, the cross-flow blower and the air outlet. Guide plates may be  
20 mounted or built into the cover or may be an integrated part of the frame. In one embodiment a guide is integrated with a support member for one or more of the other elements of the ventilation unit. A very compact unit with good aerodynamic properties may be realised in this way.

25 When designing a ventilation aggregate from standard ventilation units, heating, cooling and/or ventilation requirements of a room may lead to an optimum ventilation aggregate length that is too short to fit naturally into the room, i.e. to give an acceptable aesthetic appearance of the ventilation aggregate. Hence, dummy units may advantageously be connected to the ventilation aggregate to obtain the  
30 optimum ventilation aggregate length for the room. Such dummy units may preferably comprise an empty frame with a cover, however in some cases it is advantageous to handle one or more of the distribution systems inside the dummy unit. This is e.g. particularly useful when installing a ventilation aggregate in a building after construction is completed, since it may otherwise be difficult or  
35 expensive to connect distribution systems to the ventilation aggregate.

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In one preferred embodiment, each ventilation unit, except from optional dummy unit or units, is equipped with a motor for driving a cross-flow blower. Hence, only one type of ventilation unit, except from optional dummy unit or units, will be needed to  
5 prepare any length of ventilation aggregate. This is highly desirable from a production and distribution point of view.

The ventilation unit may in one preferred embodiment be equipped with inlet and/or outlet filters. The filters may be of a substantially physical type for removal of e.g.  
10 dust, aerosols, insects, allergens, noise and/or particles or of a substantially chemical or biological type for removal of e.g. smell, allergens and/or aerosols. In a preferred embodiment, a combined filter is used.

The filter or filters may preferably be connected to or integrated with the cover or the  
15 frame. Filters should be removable or assessable for replacement or maintenance like for example cleaning. For a ventilation unit with fresh-air inlet, an extra inlet filter may advantageously be placed at the fresh-air inlet, which may be separated considerably from the ventilation unit.

If the ventilation unit is equipped with both an inlet and an outlet filter, these filters  
20 need not be the same type. For example the inlet filter may be a particle filter or a mechanical filter, whereas the outlet filter may be a chemical or biological filter. With this arrangement, particles will not be able to damage the ventilation unit and any trace of smell from e.g. lubricants arising from within the ventilation unit may be  
25 removed.

It is highly advantageous to provide a safety switch for automatically stopping of the rotation of the cross-flow blower to prevent physical damage. The switch should be activated when access to the interior of the ventilation unit is possible, for example if  
30 the cover is removed. The safety switch may work by mechanical means or by electrical or electronic means. The rotation of the cross-flow blower should stop soon after the activation of the safety switch, preferably within 10 s of activation. In one preferred embodiment, the cover is equipped with a safety lock ensuring that the cover may not be opened or removed, unless the cross-flow blower is not

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rotating. Such a safety lock may advantageously be combined with the described safety switch.

5 In a larger system like a building with a number of rooms equipped with ventilation aggregates in some or all of the rooms, the operation mode of the aggregates should preferably be individually adjustable. For example an aggregate in a hall may be operated in heating mode while another aggregate in an office may work in fresh-air mode and an aggregate in a food storage room may work in cooling mode independently. It may not be feasible or desirable to have all modes of operation -  
10 that is heating, cooling, fresh air or any combination thereof - available for all aggregates, but the available modes of operation should be selectable for each aggregate independently of other aggregates. One way of making individual selection of mode possible is to use two-string distribution systems for heat exchange medium or by using individual distribution systems for each room.

15

In one embodiment, the ventilation units are equipped with one distribution system for heat exchange medium and the medium may be changed according to the season. Preferably, during winter the distribution system will transport a medium for heating purposes and during summer the distribution system will transport a medium  
20 for cooling purposes. Hence, the available modes of operation for such units will change dependent on the available heat exchange medium.

The rate of heat exchange in cooling and heating mode is controlled by a combination of controlling the flow rate of the heat exchange medium and rotation  
25 speed of the cross-flow blower. Increasing the rotational speed will enhance the convection effect and increase the degree of turbulence and hence increase the heat transferred. Within normal operating rotational speeds, which are typically from 0 to about 2000 rounds per minute in discrete steps or continuously, however, higher rotational speeds may be used, the heat transfer will change by a factor of  
30 about 2 to 8 at maximum rotational speed. It is therefore desirable to also be able to vary the flow rate of the heat exchange medium to increase this factor. Particularly, the heat exchange, when the cross-flow blower is not activated, may be decreased considerably resulting in energy savings for example during night when ventilating requirements are limited.

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A ventilation unit according to the invention is operated by sucking air from a first area and blowing the air to a second area. The first and second areas may be near to each other like for example in the same room. The desire to make the ventilation unit small to enhance the freedom of arranging a ventilated room is to be compared with the need for the inlet to be separated enough from the outlet to ensure that the same body of air is not continuously circulated. Blowing the outlet air away from the inlet may ensure this. In Figure 4 are shown some examples of arrangements where this is ensured. The first area and the second area may, however, be separated considerably, particularly when the fresh air is used. Then the inlet may be on the other side of a wall or the inlet may be connected to a fresh-air distribution system for the individual room or a central fresh-air distribution system. In one preferred embodiment, two inlets are used - one for circulated air placed in the same room as the outlet and one inlet for fresh air.

If the ventilation unit is equipped with a heat exchanger, the air may interact with the heat exchanger before or after the cross-flow blower. It is preferred that the heat exchanger is positioned after the cross-flow blower, as this gives rise to a desired increase in the heat transfer rate. As described previously, the air may interact with one or more filters between the inlet and the outlet.

When cooling the ventilated air, it is preferred to have the heat exchanger placed after or below the cross-flow blower, since air with a relative humidity above 100% may lead to formation of condensate on guide plates or the cross-flow blower.

In one preferred embodiment, the ventilation unit is equipped with more than one heat exchanger. This may for example be the case when the unit is designed for both cooling and heating or if the distribution system for heat exchange medium is separated in two pipes with convector plates and the cross-flow blower is placed between the pipes. In one preferred embodiment, the heat exchangers are connected by convector plates to form a heat exchanger agglomerate. Such agglomerates are easier and faster to mount to the holding members or to the frame.

The heat exchange medium or media may be selected from the broad range of suitable media. For cooling purposes preferred heat exchange media are high

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efficiency media, which are environmentally friendly or acceptable. The cooling media may be in liquid or gaseous state and the heat exchange process may involve a change of state. For heating purposes it is preferred to use a heat exchange medium, which has high heat capacity, and it is most preferred to use a water-based heat exchange medium.

### BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a ventilating unit with a single-pipe internal distribution system for heat exchange medium,  
Figure 2 shows some embodiments of ventilating units where the distribution system for a heat exchange medium is connected near one end of the ventilating unit,  
Figure 3 shows some embodiments of ventilating units where the distribution system for a heat exchange medium is connected near two ends of the ventilating unit,  
Figure 4 shows a cross section of various geometrical configurations of elements in ventilating units,  
Figure 5 shows various geometrical configurations of convector plates for heat exchangers in ventilating units,  
Figure 6 shows principles of external distributing systems for the heat exchange medium, and  
Figure 7 shows an embodiment of a ventilating aggregate providing heating, cooling and fresh air.

### DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1A shows a top view of two ventilating units 1, 14. The units are prepared for being connected functionally to form a ventilating aggregate. The elements of each unit are placed in a frame 2 for easy and fast installation. The frame is equipped with holes or areas 8, 9, 10, 13, which may be easily removed to form holes, e.g. by being perforated along the edge. The position and number of holes may vary without considerably depending on the position and type of distribution systems. Holes 8 may typically be used for connecting to external distribution systems. Hole 9 may be used for a straight connection to an external distribution system for heat exchange

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medium. Holes 13 are used for connecting of rotational force between ventilating units of the same ventilating aggregate. Hole 10 may be used for straight connection of distribution system for heat exchange medium to either external distribution systems or for connection to a further unit.

5

In the first ventilating unit 1, a motor 4 is connected to a cross-flow blower 3 with one impeller. The cross-flow blower may have more than one impeller and in such cases it is preferred that holding members (not shown) are placed between impellers for supporting purposes. Near the opposite end of the motor, a holding member 11 for supporting the cross-flow blower is seen. The holding member 11 is prepared for connection to the connecting member 15 for transfer of rotational force from a first ventilating unit 1 to a second ventilating unit 14. A holding member 12 supports the connection between the connecting member 15 and the cross-flow blower of the second unit 14.

15

The units are equipped with a heat exchanger 5 that has convector plates 7 along at least the part of the heat exchanger close to the cross-flow blower 3. The heat exchanger is prepared for connection to a distribution system for heat exchange medium towards the ends of the units by being equipped with snap fittings 6. In the second ventilating unit 14, the distribution system for heat exchange medium is equipped with a connecting means 16 extending beyond the frame 2 prepared for fast and secure connection to a snap fitting 6.

20

In Figure 1B, the two ventilation units are connected to form a ventilating aggregate. The external distribution system for heat exchange medium 20 is connected to the snap fittings 6 of the ventilating units via two of the openings 8.

25

The invention is not restricted to the case, where the units have the same lengths, however, this is a preferred embodiment, since the number of parts can be limited considerably compared to the state of the art ventilating systems. The low number of parts is highly appreciated by manufacturers and retailers. For example only one length of frame, pipe, convector and cross-flow blower, respectively, is needed.

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Alternatively, as shown in Figure 1C, ventilating units may be integrated into one frame, thereby for example reducing the need for heat exchangers.

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For all the ventilating units shown in Figure 2, the distribution system for heat exchange medium may be connected to external distribution systems or to a further unit near the second end only. Such units are therefore particularly useful as end units or as small ventilating aggregates consisting of only one unit. Figures 2A and 2B show ventilating units, where the cross-flow blower is placed towards the middle of the frame. The heat exchange medium distribution systems shown are connected in a U-shape at the first end. The U-shape may be formed by connecting snap or quick fittings 6 of the distribution systems with a flexible tube or a pipe 30a as shown in Figure 2A, or the distribution system and heat exchanger may have a built in U-shape 30b as shown in Figure 2B. Optional convector plates may be separated into the two sides 7 of the cross-flow blower as shown in Figure 2A, or connected 31 as shown in Figure 2B. The connected convector plates may surround the cross-flow blower or have a groove where the cross-flow blower may be installed. Preferred embodiments of convector plates are shown in Figure 5.

The ventilation unit shown in Fig 2B has a simple holding member 11a that is not prepared for transmitting of rotational force to a further unit. Furthermore, the hole for connecting of rotational force may be omitted 13a. This unit is particularly simple to produce, however, when this type of unit is connected to further units, such further units must be equipped with a motor.

In Figure 2C, a ventilating unit with a U-shaped distribution system for heat exchange medium is placed on the same side of the cross-flow blower. The ends of the distribution system for heat exchange medium have threads 36 as an example that standard fittings may be used for the connections. The rotation speed of the motor 4 is controlled by a controller unit 32, which may or may not be placed inside the ventilating unit. The controller unit is furthermore connected to one or more temperature sensors that may be positioned inside 33 or outside 34 of the ventilating unit. For controlling of the heat exchange rate, the controller may also be connected to a valve 35 for adjusting the flow rate of the heat exchange medium. The holding member 37 for supporting of the cross-flow blower near the second end may be built into the frame as shown in Figure 2C.

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A safety switch 38 is placed near a relevant opening, in this case near the cover; however, in other designs it may be appropriate to protect other openings than the cover with a safety switch. When the cover is removed, the safety switch should ensure that the rotation of the cross-flow blower is brought to a rapid stop, preferably within 10 seconds. The safety switch may be connected to a safety controller or directly to the motor. Another safety feature shown in Figure 2C is a safety lock ensuring that the cover can not be opened before the cross-flow blower has stopped. A safety lock and a safety switch need not to collaborate and may provide two independent safety systems. If a safety controller is used for controlling the interaction with a safety switch and/or a safety lock, the safety controller may or may not be integrated with the controller 32.

The heat exchanger shown in Figure 2A, B and C has two pipes forming a plane, which is parallel to the bottom of the frame, but other arrangements are feasible. For example the pipes may be positioned in a way, whereby a plane defined by the pipes forms an angle to the bottom of the frame, preferably an angle of between 45° to 135° and more preferably an angle of about 90°. In this case, the pipes may be placed next to the cross-flow blower or in an over/under configuration. With such configurations very compact units may be formed - even if both a distribution system for a heating medium and a distribution system for a cooling medium are needed.

Ventilating units as those shown in Figure 2 are often connected functionally to further units to form larger ventilating aggregates. In Figure 3, examples of suitable further units are shown in a top view. The cover and guide plates are omitted to enhance clarity.

The connection means for connecting the distribution system for the heat exchange medium may be a stiff connection as shown in Figure 1, however, it is appreciated that a certain flexibility is present in the connection. In Figure 3A, the connection means are flexible tubes 40, which are connected to the distribution system and heat exchanger via snap fittings. In Figure 3B, an example of a distribution system being flexible is used. The connection means 41 may hence be formed directly by the distribution system with fittings. As in Figure 2B, the ventilating unit in Figure 3B is equipped with a motor, since the first unit is not supplied with means for transfer of rotational force from that unit. The ends 42 of the distribution systems for heat



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transfer medium away from the motor are prepared for connection to further units or to an external distribution system.

5 The distribution system for heat exchange medium and heat exchanger shown in Figure 3A is not equipped with convector plates. This is a preferred embodiment, if only a low heat exchange rate is desired in a room, where the ventilating aggregate should be long to provide an aesthetic look. Alternatively, ventilating units with convectors may be used and some of the units may be replaced by dummy units, as described above.

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The cross-flow blower shown in Figure 3A has two impellers 45. In some cases, e.g. when the unit is very long or if smaller impellers are economically favourable, it may be advantageous to use a cross-flow blower with two or more impellers. The impellers may for example be connected by a common shaft or by a connection means and the connection may or may not be supported. In Figure 3A, a holding member 46 supports the connection.

15 Figure 3C shows a very simple ventilating unit, which for example may be connected to the unit shown in Figure 2C by the connection means 44 and the tap extending from the holding member 43 built into the frame. The cross-flow blower is connected to holding members built into the frame and the distribution system for the heat exchange medium and the heat exchanger is a simple double-tube convector prepared for connection at the ends 36. These connections may e.g. be of a quick fitting type or as shown in Figure 3C of a standard threaded type. The connection means 44 are preferably flexible to absorb any imperfection arising from installation or manufacture of the units.

20 The elements of a ventilating unit may be positioned in a number of ways within the scope of the invention. In Figure 4 some preferred embodiments are shown in schematic cross sectional views. Figure 4S shows a simple ventilating unit with fresh-air inlet from a first area 57 through a wall 56 via a cross-flow blower 3 to a second area 58. The fresh-air inlet may extend at full length of the ventilating unit or the ventilating aggregate, however, extended inlets through walls are not desired, since it may weaken the building. The fresh-air inlet may therefore advantageously be separated into one or more smaller inlets or holes. If the fresh air needs to be

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transported over extended distances, a separate blower for the transportation to the ventilating unit may be used (not shown).

5 A ventilating unit according to the invention may be equipped with a distribution system for heat exchange medium and heat exchanger, which will generally be indicated as a circle corresponding to a round pipe 5 in Figure 4. This indicates that the distribution system/heat exchanger is placed substantially parallel to the cross-flow blower, which is the preferred relative positioning. Other types, shapes and relative positioning of the distribution systems and heat exchangers may be used.

10

In Figure 4, the arrows indicate the dominating airflow but by changing of the rotational direction and/or the shape of the cross-flow blower, the flow direction may be inverted.

15 Figures 4A and 4N show simple units with a cross-flow blower 3 and a heat exchanger 5. Figure 4A is shown in a blow configuration and Figure 4N is shown in a suck configuration to indicate that the direction of the airflow may be inverted, as described above. These units are cheap to produce but may provide some turbulence and it is hence advantageous to provide guide plates 50, 51, 52, 53 to  
20 enhance a laminar character of the airflow, as shown in Figures 4B and 4C. The guide plates may be simple smaller elements as guide plates 50 and 51 in Figure 4B or larger plates with more complex shapes as for example guide plates 52 and 53 in Fig 4C. When convenient, one or more of the guide plates may be incorporated or connected to other elements of the unit like for example the frame or the cover  
25 (generally not shown in Figure 4 to enhance clarity). The guide plates shown in Figure 4 merely indicate general principles of preferred shapes and the shapes should not be considered an exhaustive group of possible designs.

Often the ventilating units are equipped with more than one distribution system pipe  
30 or heat exchanger. These distribution systems may be delivery and return systems or distribution systems intended for different heat exchange media. In a preferred relative positioning of distribution system(s) and cross-flow blower the distribution system is placed in a plane or close to forming a plane as indicated in some of the examples in Figure 4. (e.g. 4D, E, F, I, K, L, M, O, P and Q). Another approach is to  
35 organise the distribution system or heat exchanger relatively and the cross-flow

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blower to form two planes with an angle of between about 45° and 135°, as indicated by other examples in Figure 4 (e.g. 4G, H, J, R and T). Particularly an angle of 90° is a preferred embodiment. As shown in for example Figure 4U, other embodiments than these are possible within the scope of the invention.

5

The distribution system or the cross-flow blower need not be built from pipes with a circular cross section. For example the ventilating units shown in Figures 4O and 4P have an elongated cross section 54, 55.

10

In a preferred embodiment, the heat exchanger comprises convector plates. These convector plates may for example be placed on a pipe to form a combined heat exchanger and distribution system for heat exchange medium or be part of a traditional convector. In Figure 5 some examples of types of convector plates are shown.

15

In Figures 5A and 5D, examples of pipes with convector plates are sketched in a cross sectional view. In Figure 5E, a convector with two pipes and shared convector plates is shown. These pipes may e.g. be a delivery pipe and a return pipe belonging to the same distribution system for heat exchange medium, however, the pipes could also belong to two distribution systems. These distribution systems may be for a heating medium and for a cooling medium or alternatively for distribution of fresh air. Ventilating units with distribution systems with three or more pipes are not shown for clarity reasons but such systems may or may not be equipped with individual or shared convector plates.

25

To increase the heat transfer rate, the cross-flow blower may be integrated into or placed inside the convector plates as shown in Figures 5B, C, F, G, H and I. The accessibility to the cross-flow blower during maintenance like for example cleaning may be enhanced with an opening or groove in the convector as shown in Figure 5I.

30

Ventilating units according to the invention may for example be installed in floors, walls, ceilings, window sills, door sills, skirtings or built into tables.

A number of types of distribution systems for heat exchange medium or fresh air may be suitable. In Figure 6 four examples of useable systems are shown. Figure

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6A is an external distribution system 62 based on a standard one-string system where a fraction of the medium is introduced into a ventilating aggregate 61. Figure 6B shows a standard two-string system, where a fraction of the medium is introduced into the ventilating aggregate and returned into the return pipe. Figure 6C shows a one-string system, where the entire medium is introduced into the ventilating aggregate and afterwards circulated on to other aggregates. The system in Figure 6D is a simple system where each ventilating aggregate has an individual distribution system. The distribution system shown Figure 6D is a preferred embodiment, since this system is particularly easy to control.

10

The ventilating aggregates 61 are shown with the medium entering the ventilating aggregate in one end and exiting the ventilating aggregate in the other end. In some applications it is more convenient to use a ventilating aggregate with medium entering and exiting near the same end of the ventilating aggregate. In this case, the internal distribution system of one of the ventilating units should be equipped with a U-shape as shown in Figure 2.

15

The ventilating aggregate shown in the exploded view of Figure 7 may provide heating, cooling and/or fresh air. The aggregate is shown positioned vertically on a wall and comprises ventilating units dedicated to heating 70, cooling 71 or fresh air 72. To realise a good mixing of air in the room without a draught, it is preferred that the heating compartment is placed towards the floor 76 of the room, the cooling compartment is placed towards the ceiling 77 and the fresh-air compartment is placed between the heating and the cooling compartment.

20

The fresh-air compartment is connected to a supply 75 of fresh air, preferably the outside and an air filter 74. In Figure 7, the air filter is shown after the cross-flow blower, however, the filter may also be placed before the cross-flow blower like for example at the inlet to the fresh-air supply.

25

Each compartment may comprise one or more ventilating units dedicated to the purpose of the compartment depending on the specific ventilating needs of the room. Alternatively, more compartments may be integrated into one unit, which may constitute a ventilating aggregate. A ventilating aggregate comprising more dedicated compartments may be placed in any position relative to the floor, wall or

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ceiling as other ventilating aggregates according to the invention, however, it is preferred that a ventilating aggregate comprising more dedicated compartments is placed vertically.

- 5 To enhance the mixing of air in the room, the cover may be provided with air guides 73. As shown in Figure 7, these air guides are preferably oriented to direct the outlet air downwards from the heating compartment and upwards from the cooling compartment. The air guides may be fixed or movable. Movable air guides may e.g. be able to direct the outlet air in a number of fixed directions, or the guides may be
- 10 able to perform a sweeping movement for example by means of an electrical motor (not shown). In Figure 7, air guides are shown on the side of the ventilating device facing towards the room, however, the sides parallel or at an angle to the walls may also be equipped with air outlets and hence air guides. In some situations, it may be preferred to only use air outlet in a direction parallel to walls as this will reduce the
- 15 linear air velocity into the room and hence may reduce the feeling of a draught.

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LIST OF REFERENCE

No.	Description
1	First ventilating unit
2	Frame
3	Cross-flow blower
4	Motor
5	Heat exchanger
6	Snap fitting
7	Convactor plate
8	Hole for sideways connection to external distribution system
9	Hole for straight connection to external distribution system
10	Hole for straight connection to external distribution system or a further unit
11	Holding member
11a	Simple holding member
12	Holding member
13	Hole for connecting of rotational force
13a	Omitted hole
14	Second ventilating unit
15	Connecting member for transfer of rotational force
16	Connecting means
20	Connection to external distribution system
30a	Flexible tube or U-shaped pipe
30b	Distribution system and heat exchanger with a built-in U-shape
31	Connected convactor plates
32	Controller unit
33	Internal temperature sensor
34	External temperature sensor
35	Valve
36	Threads
37	Holding member
38	Safety switch
39	Safety lock
40	Flexible tube

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41	Connection means
42	End of the distribution system
43	Holding member built into frame
44	Connection means
45	Impeller
46	Holding member
50	Guide plate
51	Guide plate
52	Guide plate
53	Guide plate
54	Pipe with elongated cross section
55	Pipe with elongated cross section
56	Wall
57	First area
58	Second area
60	Convactor plate
61	Ventilating aggregate
62	External distribution system
70	Compartment for heating
71	Compartment for cooling
72	Compartment for fresh air
73	Air guide
74	Air filter
75	Supply of fresh air
76	Floor
77	Ceiling

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CLAIMS

1. A ventilating aggregate with at least one ventilating unit, said ventilating unit comprising:
  - 5                   - a cross-flow blower with one or more impellers
  - means for driving said cross-flow blower
  - means for connecting a unit functionally to further ventilating units and/or an external distribution system.
- 10   2. A ventilating unit according to claim 1, characterised in that the means for driving the cross-flow blower is a motor or a connection transferring rotational force from another cross-flow blower.
- 15   3. A ventilation unit according to any of the claims 1 to 2, characterised in that at least a fraction of the ventilated air is fresh air.
4. A ventilating unit according to any of the claims 1 to 3, further comprising a heat exchanger.
- 20   5. A ventilating unit according to any of the claim 4, characterised in that the heat exchanger is selected from the group comprising a pipe, a pipe with convector plates, a convector, a plate convector or a radiator.
- 25   6. A ventilating unit according to any of the claims 4 to 5, characterised in that the heat exchanger is positioned in the vicinity of the cross-flow blower.
- 30   7. A ventilating unit according to any of the claims 4 to 6, characterised in that the heat exchanger extends substantially the length of the impeller of the cross-flow blower.
8. A ventilating unit according to any of the claims 4 to 7, characterised in that the air flow near the heat exchanger is mainly laminar to reduce noise.



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9. A ventilating unit according to any of the claims 1 to 8, characterised in that the resources to be connected functionally to further ventilating units by means for connecting are one or more of:

- fresh air
- 5       - heat distribution medium
- electrical power
- rotational force between cross-flow blowers;

said means for connecting are preferably of the male/female type or snap connection type.

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10. A ventilating aggregate according to claim 1 with at least two ventilating units.

11. A ventilating aggregate according to claim 10, characterised in that all of the ventilating units are alike.

15

12. A ventilating aggregate according to claim 10, characterised in that at least two of the ventilating units are different, preferably the end unit is different from the other units.

20   13. A ventilating unit according to any of the claims 1 to 12, further comprising a frame, said frame being optionally equipped with a snap connection for connecting to other frames.

25   14. A frame according to claim 13 comprising members for supporting the cross-flow blower and/or a heat exchanger.

15. A ventilating unit according to any of the claims 1 to 14, further comprising a holding member for supporting the cross-flow blower and/or the heat exchanger.

30   16. A ventilating unit according to any of the claims 1 to 15, further comprising a cover.

17. A cover according to any of the claims 13, 14 or 16, characterised in that said cover is releasably connected to the frame.

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18. A cover according to claim 16, characterised in that said cover is releasably connected to the holding member.
- 5 19. A cover according to any of the claims 16 to 18, characterised in that said cover has openings therein to allow air to flow towards and/or from the cross-flow blower.
- 10 20. A cover according to any of the claims 16 to 19, characterised in that the openings in said cover are shaped or directed to decrease draught.
21. A cover according to any of the claims 16 to 20, characterised in that the openings in said cover are shaped or directed to realise a linear air velocity of less than 2 meters per minute in the areas frequented by users of the room.
- 15 22. A cover according to any of the claims 16 to 21, characterised in that said cover is adapted to reduce the emitted noise.
23. A cover according to any of the claims 16 to 22, comprising members for supporting the cross-flow blower and/or the heat exchanger.
- 20 24. A cover according to any of the claims 16 to 23 adapted to being easily exchanged with a second cover having a second appearance, thereby providing means for fast change of the visual appearance of a ventilating unit or a ventilating aggregate.
- 25 25. A ventilating unit according to any of the claims 2 to 24, further comprising a guide plate for controlling of the airflow.
- 30 26. A ventilating unit according to claim 25, characterised in that a guide plate is shaped to reduce the emitted noise.
27. A ventilating unit according to any of the claims 25 to 26, characterised in that a guide plate is shaped to reduce the degree of turbulence in the airflow.

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28. A guide plate according to any of the claims 25 to 27, comprising members for supporting the cross-flow blower and/or the heat exchanger.
29. A ventilating dummy unit comprising
- 5                   - a frame
- a cover
- said dummy unit being connectable to a ventilating unit according to any of the claims 2 to 28.
- 10   30. A ventilating dummy unit according to claim 29, characterised in that said dummy unit is adapted to be adjusted with regard to length.
31. A ventilating unit having a first end and a second end comprising:
- a cross-flow blower
- 15               - a motor
- an internal distribution system for a heat exchange medium comprising a heat exchanger.
- 20   32. A ventilating unit according to claim 31, characterised in that at the second end of the ventilating unit, the internal distribution system for heat exchange medium is prepared for connecting to a further ventilating unit or an external distribution system for heat exchange medium.
- 25   33. A ventilating unit according to any of the claims 31 to 32, further comprising a holding member for supporting the cross-flow blower towards the second end of the ventilating unit, said holding member being prepared for supporting of transfer of rotation between the cross-flow blower of the ventilating unit and a cross-flow blower of an optionally connected further ventilating unit.
- 30   34. A ventilating unit according to any of the claims 31 to 33, characterised in that the internal distribution system for heat exchange medium comprises a delivery pipe and a return pipe and that near the first end of said ventilating unit, said delivery pipe and said return pipe are connected.
- 35   35. A ventilating unit having a first end and a second end comprising:

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- a cross-flow blower
- means for driving said cross-flow blower
- an internal distribution system for a heat exchange medium comprising a heat exchanger

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36. A ventilating unit according to claim 35, characterised in that at the first end of said ventilating unit, the internal distribution system for heat exchange medium is prepared for connecting said unit functionally to a second end of a further ventilating unit.

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37. A ventilating unit according to any of the claims 35 to 36, characterised in that at the second end of said ventilating unit, the internal distribution system for heat exchange medium is prepared for connecting said unit functionally to a first end of a further ventilating unit or to an external distribution system for heat exchange medium.

15

38. A ventilating unit according to any of the claims 35 to 37, characterised in that at the first end of the ventilating unit, the cross-flow blower is prepared for receiving a rotational force transferred from a second end of a cross-flow blower of a further ventilating unit.

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39. A ventilating unit according to any of the claims 35 to 38, characterised in that the means for driving the cross-flow blower is a rotational force transferred from a second end of a cross-flow blower of a further ventilating unit.

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40. A ventilating unit according to any of the claims 35 to 39, further comprising a holding member for supporting the cross-flow blower towards the second end of the ventilating unit, said holding member being prepared for supporting of transfer of rotation between the cross-flow blower of the ventilating unit and a cross-flow blower of an optionally connected further ventilating unit.

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41. A ventilating unit according to any of the claims 35 to 37 or 40, characterised in that the means for driving the cross-flow blower is a motor.

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42. A ventilating unit according to any of the claims 1 to 41, characterised in that the cross-flow blower is positioned at least partially integrated in a convector connected to the internal distribution system for a heat exchange medium.
- 5 43. A ventilating unit according to any of the claims 1 to 42, characterised in that the internal distribution system for the heat exchange medium comprising a heat exchanger, comprises two pipes, preferably a pipe for delivering of heat exchange medium and a pipe for returning of heat exchange medium.
- 10 44. A ventilating unit according to claim 43, characterised in that the pipes belonging to the distribution system for the heat exchange medium are positioned substantially parallel to the cross-flow blower.
- 15 45. A ventilating unit according to any of the claims 43 to 44, characterised in that the pipes belonging to the distribution system for the heat exchange medium and the cross-flow blower are positioned in a plane.
- 20 46. A ventilating unit according to any of the claims 43 to 44, characterised in that the pipes belonging to the distribution system for the heat exchange medium heat exchange and the cross-flow blower form an angle of between about 45° and 135°, preferably an angle of about 90°.
- 25 47. A ventilating unit according to any of the claims 43 to 46, characterised in that the cross-flow blower is positioned between pipes belonging to the distribution system for the heat exchange medium, preferably integrated in a convector.
- 30 48. A ventilating unit according to any of the claims 43 to 47, characterised in that pipes belonging to the distribution system for the heat exchange medium are equipped with convector plates, hence constituting individual heat exchangers.
- 35 49. A ventilating unit according to any of the claims 43 to 47, characterised in that pipes belonging to the distribution system for the heat exchange medium are connected, preferably via convector plates.

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50. A ventilating unit according to any of the claims 1 to 49, further comprising an air inlet filter.
- 5 51. A ventilating unit according to any of the claims 1 to 50, further comprising an air outlet filter.
52. A ventilating unit according to any of the claims 50 to 51, characterised in that the filter at least partially removes dust, smell, allergens, aerosols, insects and/or particles.
- 10 53. A ventilating unit according to any of the claims 50 to 52, characterised in that the filter is adapted to reduce the emitted noise.
- 15 54. A ventilating unit according to any of the claims 50 to 53, characterised in that the filter is connected to or integrated in the cover.
55. A ventilating unit according to any of the claims 50 to 54, characterised in that the filter is connected to or integrated in the frame.
- 20 56. A ventilating unit according to any of the claims 1 to 55, further comprising a safety switch.
57. A ventilating unit according to claim 56, characterised in that the safety switch is activated when the cover is opened.
- 25 58. A ventilating unit according to any of the claims 56 to 57, characterised in that the safety switch is connected to a means that will stop the rotation of the cross-flow blower when the switch is activated, preferably the rotation of the cross-flow blower stops within 10 s of activation of the safety switch.
- 30 59. A ventilation unit according to any of the claims 1 to 58, further comprising a safety lock for preventing opening or removal of the cover unless the cross-flow blower is not rotating.
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60. A ventilating unit according to any of the claims 1 to 58, characterised in that the linear velocity of air in the areas frequented by users of the room is below 2 m/s in ordinary working condition.
- 5 61. A ventilating aggregate comprising dedicated compartments for heating, cooling and/or fresh air.
62. A ventilating aggregate according to claim 61, characterised in that each compartment comprises at least one ventilating unit according to any of the  
10 claims 1 to 60.
63. A ventilating aggregate according to claim 61, characterised in that more compartments are integrated into one unit.
- 15 64. A ventilating aggregate according to any of the claims 61 to 63, characterised in that the ventilating aggregate is placed vertically and that the heating compartment is placed towards the floor, the cooling compartment if present is placed towards the ceiling and the fresh-air compartment if present is placed towards the floor.
- 20 65. A system for ventilating of at least two rooms comprising a ventilating aggregate in more than one of said rooms, said system may provide one or more of heating and/or cooling and/or circulation and/or fresh air in each of said rooms; heating and/or cooling and/or circulation and/or fresh air settings may be controlled  
25 individually for each room.
66. A system for controlling of the rate of heat exchange by a combination of flow rate of the heat exchange medium and rotational speed of the cross-flow blower.
- 30 67. A system for distributing heat exchange medium to ventilating aggregates according to any of the claims 1 to 60, characterised in that the system is based on a two-string system, an individual distribution system to each room or a conventional one-string system.
- 35 68. A method of ventilating air comprising the steps of:

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- sucking air from a first area via interaction with a heat exchanger
- blowing said air to a second area
- optionally filtering the air.

5      69. A method of ventilating air comprising the steps of:

- sucking air from a first area
- blowing said air via interaction with a heat exchanger to a second area
- optionally filtering the air.

10

70. A method of ventilating air comprising the steps of:

- sucking air from a first area to interact with a first heat exchanger
- blowing said air via interaction with a second heat exchanger to a second area
- optionally filtering the air.

15

71. A method according to claim 70, characterised in that the first heat exchanger is connected to the second heat exchanger preferably via convector plates.

20

72. A method of ventilating air comprising the steps of:

- sucking air from a first area to interact with a first part of a heat exchanger
- blowing said air via interaction with a second part of said heat exchanger to a second area
- optionally filtering the air.

25

73. A method according to any of the claims 68 to 72, characterised in that the first area and the second area are directly connected.

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74. A method according to any of the claims 68 to 72, characterised in that the first area is outside the room wherein the air condition aggregate is installed.

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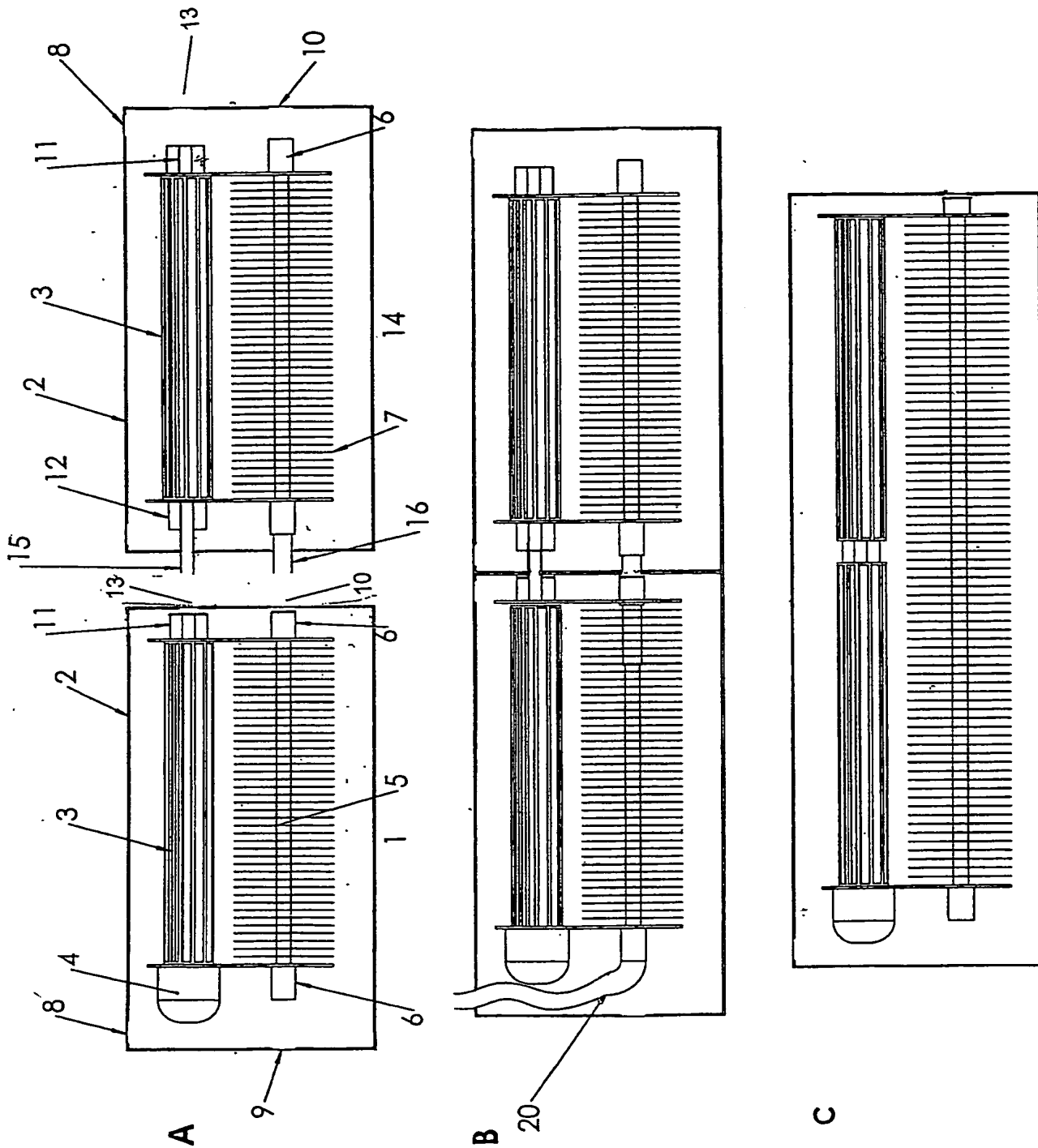


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Fig. 1

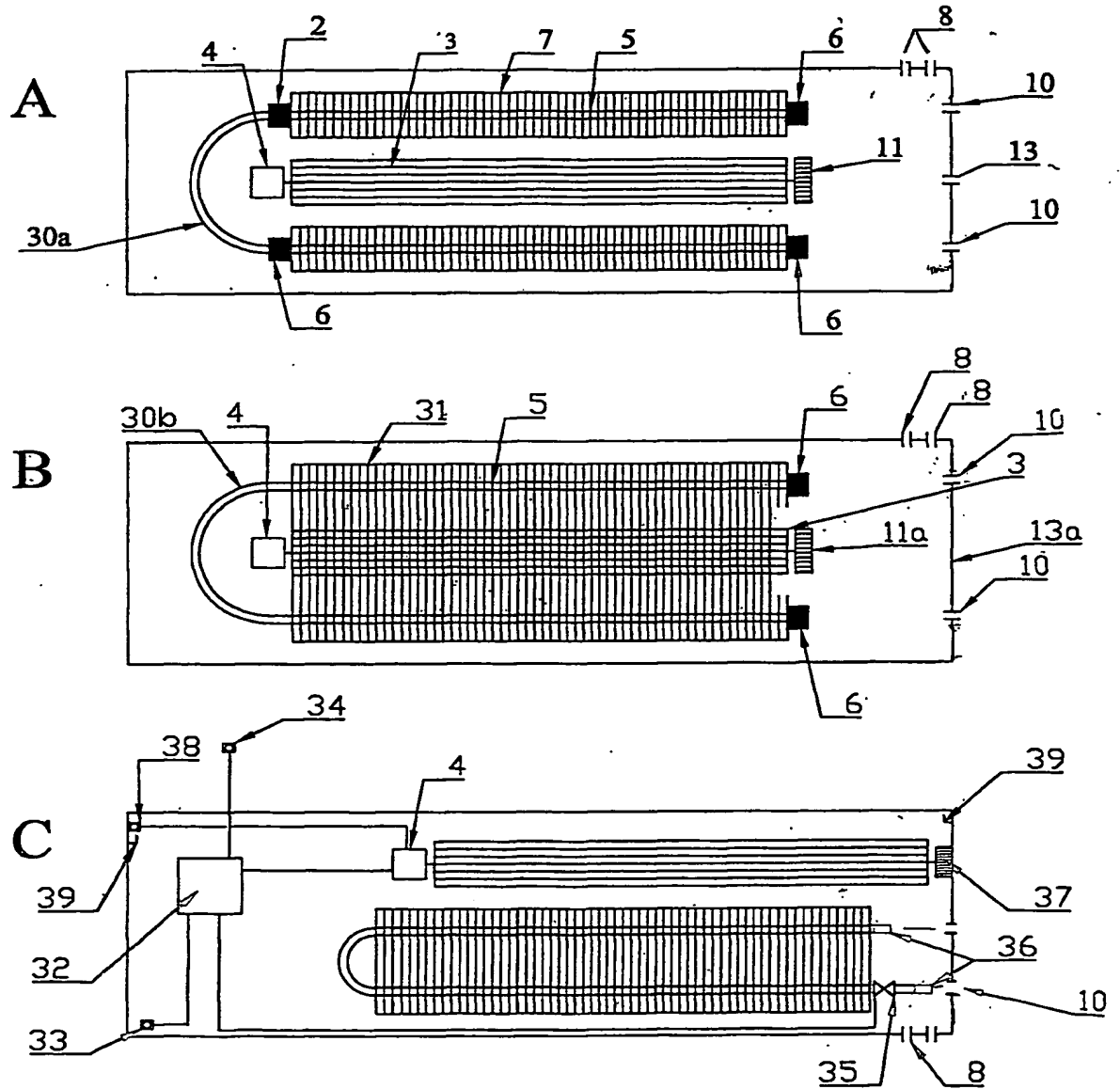


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Fig. 2

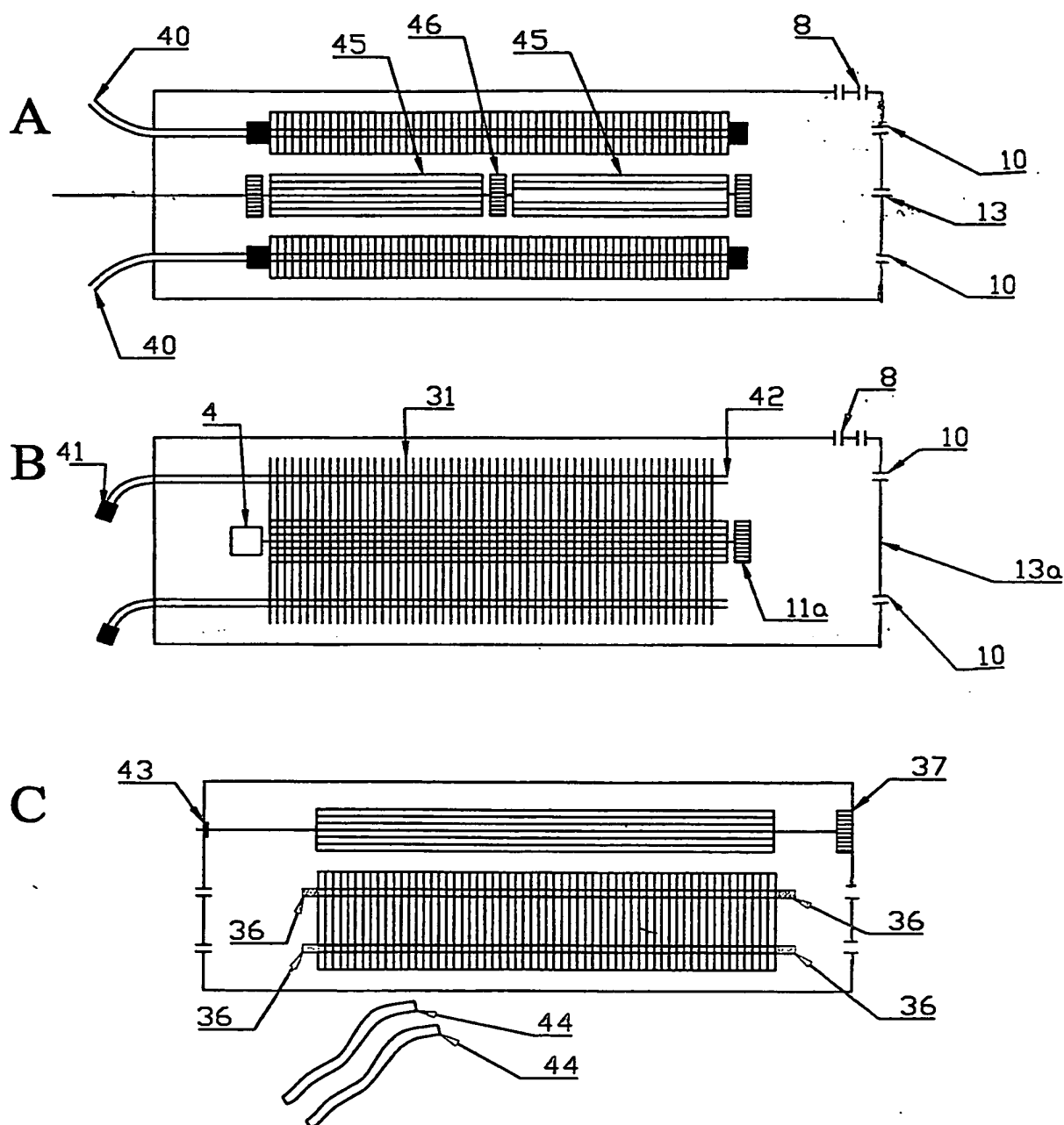


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Fig. 3

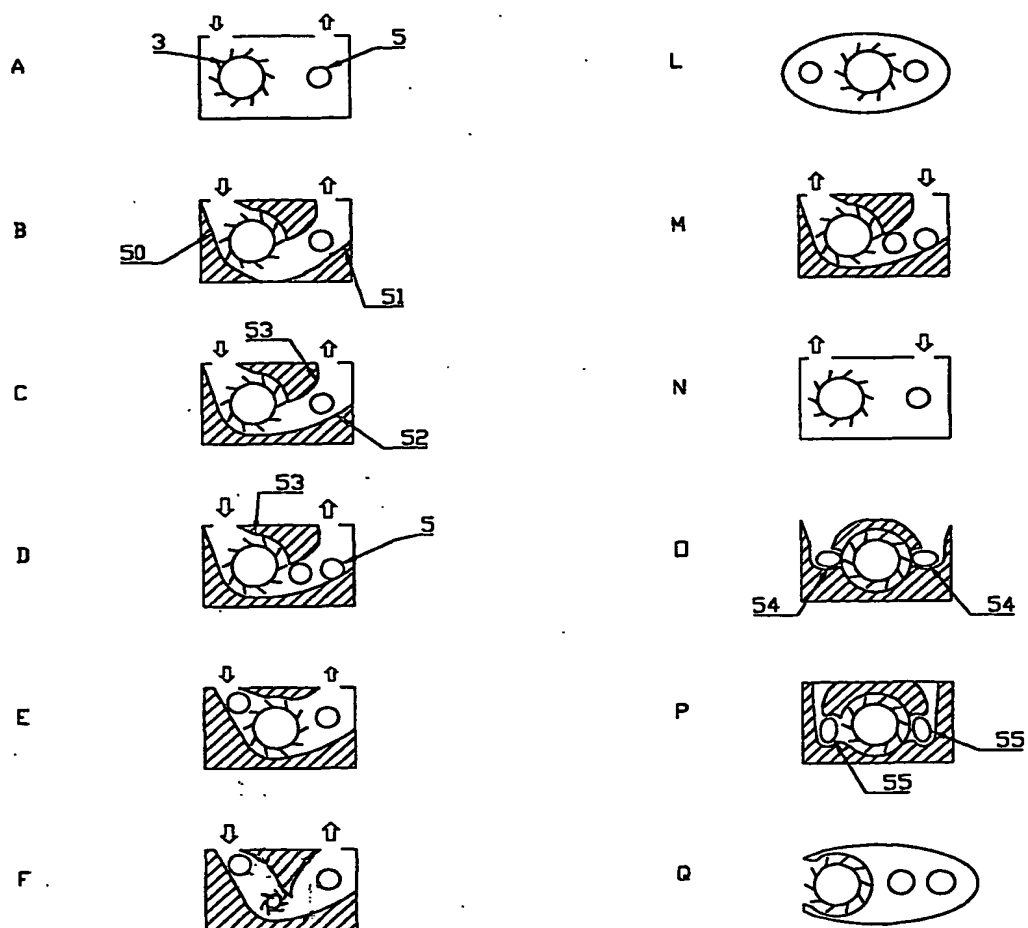


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Fig. 4a

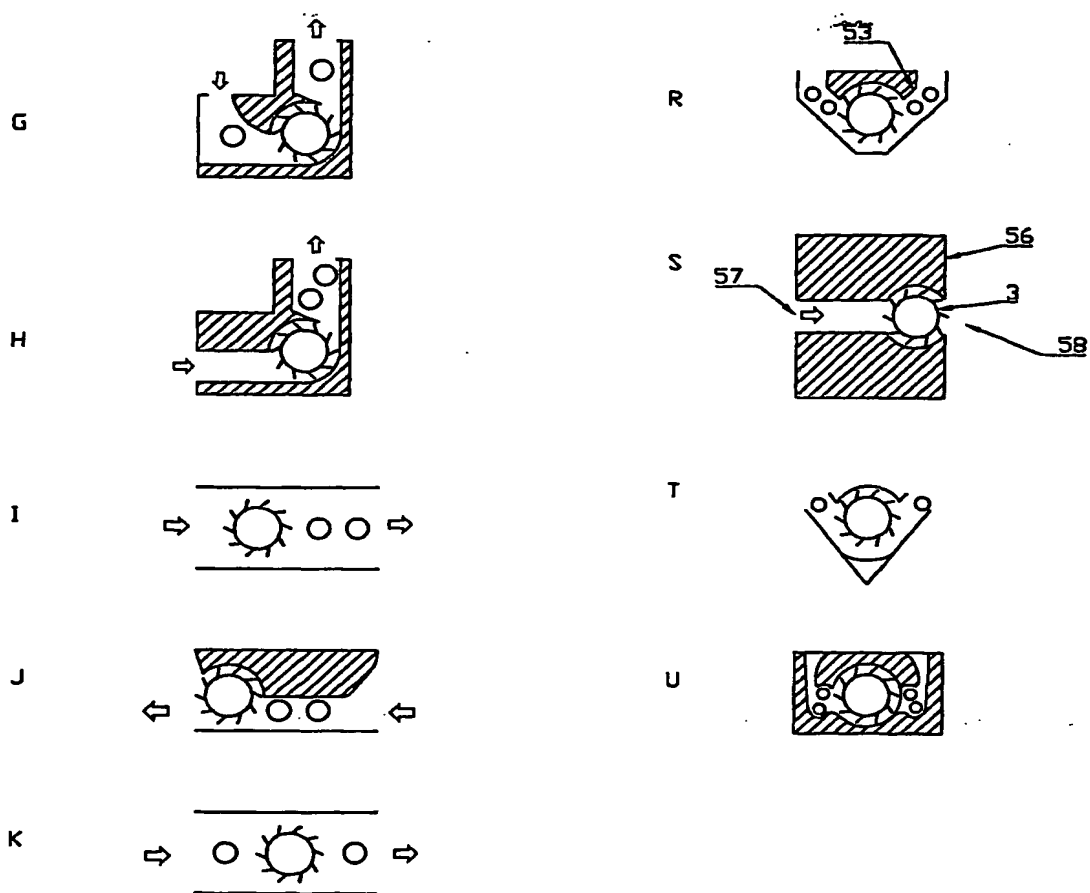


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Fig. 4B

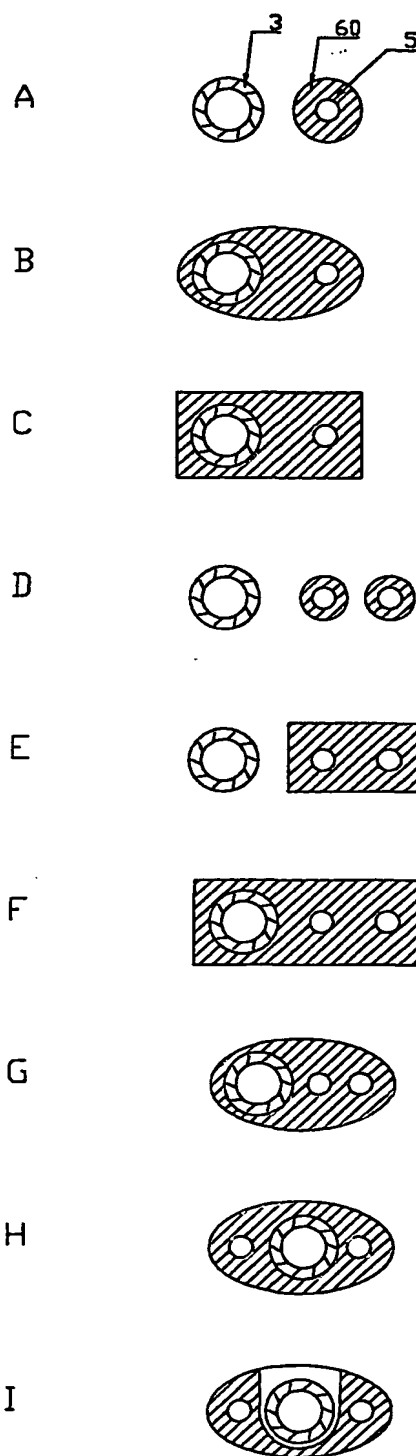


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Fig. 5

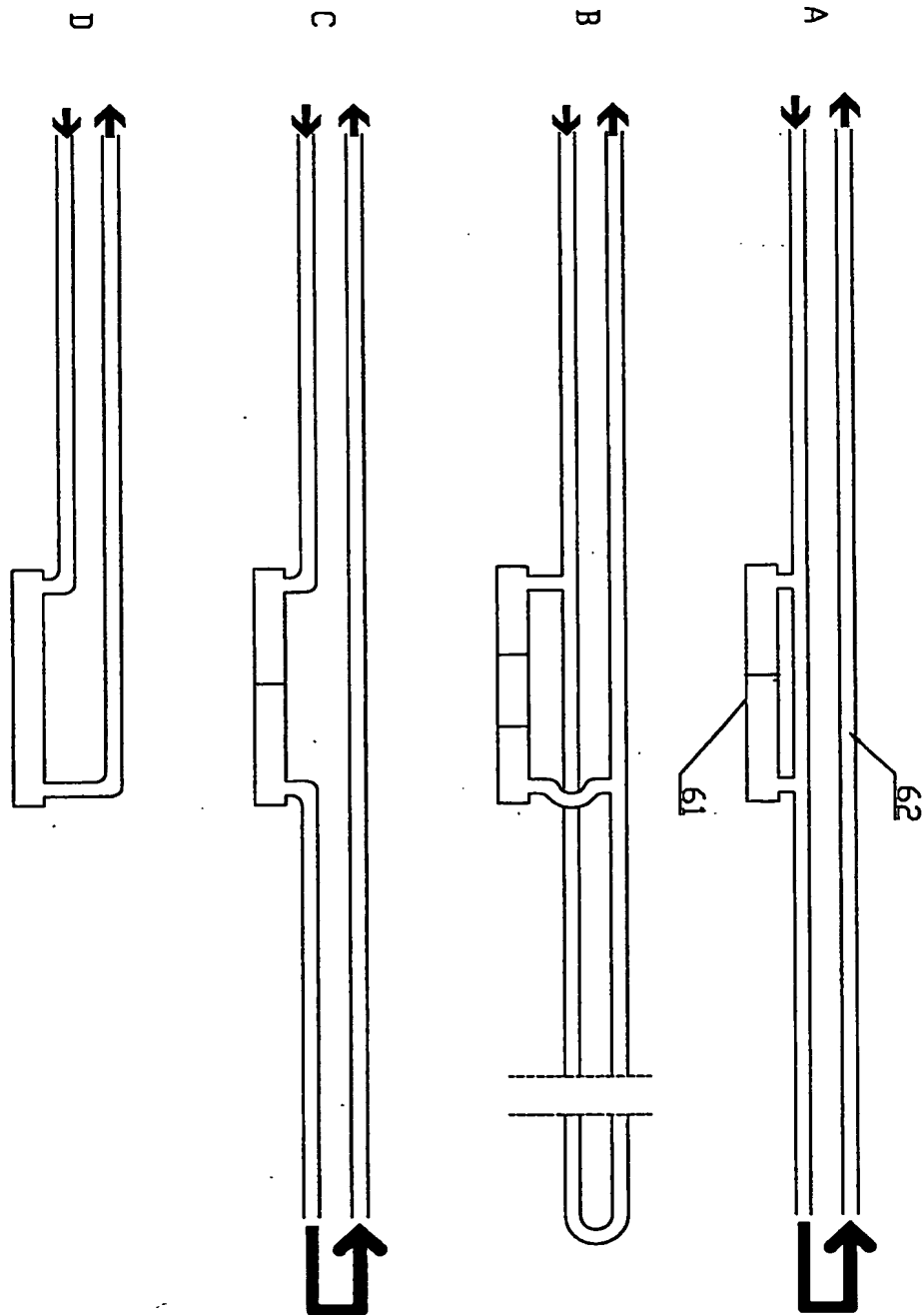


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Fig. 6



## INTERNATIONAL SEARCH REPORT

International Application No

PCT/DK 03/00077

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 F24F1/00 F24F3/00 F24F13/20 F04D29/62 F24F11/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 F24F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>WO 02 04871 A (CONVEC APS ;HANSEN OLE (DK)) 17 January 2002 (2002-01-17)</p> <p>page 2 -page 3  page 4, line 8 - line 9  page 4, line 31 - line 35  page 5, line 18 - line 35  page 6  page 8, line 10 - line 18  page 9, line 35  page 10, line 1  page 10, line 29 - line 31  page 11, line 6 - line 7  page 11, line 34 - line 35  page 15, line 13  page 15, line 19 - line 20</p> <p>-/--</p>	<p>1,2,4-6,  8,13-16,  25-28,  31,  42-50,  60-69</p>

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

## \* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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